PB-245 755

# THE IMPACT OF FARGO, NORTH DAKOTA'S WASTE DISCHARGES ON THE INTERSTATE WATERS OF THE RED RIVER OF THE NORTH, SEPTEMBER 1969-APRIL 1970

Federal Water Quality Administration
Kansas City, Missouri

July 1970

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

282008

PB 245 755

# THE IMPACT OF FARGO NORTH DAKOTA'S WASTE DISCHARGES ON THE INSTREAM WATERS OF THE RED RIVER OF THE NORTH SEPTEMBER 1969 APRIL 1970

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
MISSOURI BASIN REGION
KANSAS CITY, MISSOURI
JULY 1970

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
US Department of Commerce
Springfield, VA. 22151

## TABLE OF CONTENTS


| | | Page Number |
|---|---|---|
| I. | INTRODUCTION | 1 |
| II. | SUMMARY AND CONCLUSIONS | 3 |
| III. | RECOMMENDATIONS | 6 |
| IV. | METHOD OF STUDY | 7 |
| | A. GENERAL DESCRIPTION | 7 |
| | B. SAMPLING SCHEDULE AND COLLECTION | 7 |
| V. | DATA PRESENTATION | 12 |
| | A. FARGO SEWAGE TREATMENT PLANT | 12 |
| | B. WASTE DISCHARGES IN FARGO-MOORHEAD AREA | 18 |
| | C. STREAM STATIONS | 21 |
| | D. NUTRIENTS | 23 |
| VI. | DOCUMENTATION OF EFFLUENT CRITERIA VIOLATIONS | 25 |

## LIST OF TABLES


| Table Number | Title | Page Number |
|---|---|---|
| IV-1 | Station Descriptions . . . . . | 10 |
| V-1 | Fargo Sewage Treatment Plant Monthly Averages - Biochemical Oxygen Demand . . . . . | 14 |
| V-2 | Fargo Sewage Treatment Plant Monthly Averages - Total Suspended Solids . . . . . | 15 |
| V-3 | Monthly Average Percentages of Total pounds of $BOD_5$ discharged to the Red River of the North from the Fargo-Moorhead Area . . . . . | 19 |
| V-4 | Monthly Average Percentage of Total pounds of TSS discharged to the Red River of the North From the Fargo-Moorhead Area . . . . . | 20 |
| V-5 | Stream Stations - Monthly Averages of Dissolved Oxygen . . . . . | 22 |
| V-6 | Stream Stations - Monthly Average Nutrient Loads at Selected Stations . . . . . | 24 |
| VI-1 | Table of Standards Violations - Fargo Sewage Treatment Plant . . . . . | 26 |

## LIST OF FIGURES


| Figure Number | Title | Page Number |
|---|---|---|
| IV-1 | Map of Study Area . . . . . | 8 |
| IV-2 | Map of Fargo-Moorhead Area . . . . . | 9 |
| V-1 | Fargo Sewage Treatment Plant - Monthly Average Percentage of $BOD_5$ Reduction vs. Months . . . . . | 16 |
| V-2 | Fargo Sewage Treatment Plant - Montly Average Percentage of TSS Reduction vs. Months . . . . . | 17 |

## I. INTRODUCTION

In 1965 a Federal-State conference (Conference in the Matter of Pollution of the Interstate Waters of the Red River of the North, Minnesota-North Dakota, September 14, 1965; January 18, 1966; and March 4, 1966) was held to examine the matter of pollution on the Red River of the North. One significant conference finding was the occurrence of reduced dissolved oxygen (D.O.) concentrations. The recurring incidents of depressed oxygen levels in the Red River of the North between Fargo and Grand Forks especially during periods of ice cover resulted in the initiation of an additional field investigation by the Federal Water Quality Administration (FWQA) in cooperation with the States of North Dakota and Minnesota during the period September 1969 through April 1970.

This field survey was designed to determine the impact of waste sources in the Fargo-Moorhead area on the quality of the Red River of the North. The study area encompassed that portion of the River from Fargo-Moorhead to Oslo, Minnesota, which is 25 miles downstream from Grand Forks, North Dakota.

The survey effort provided data for answering the following questions:

1. What is the general quality of the water in the River downstream from the metropolitan areas and does this quality conform with the accepted water quality criteria as delineated in Federal-State Water Quality Standards?

2. What are the relative waste contributions from the major waste sources in the Fargo-Moorhead area?

3. What is the overall performance level of the waste treatment plants at Fargo and Moorhead, particularly during ice cover on the river which is considered the most critical period.

In answering these questions, a portion of the survey consisted of a detailed investigation of the Fargo Sewage Treatment Plant. It is the purpose of this report to outline the specific 1969-1970 survey findings that pertain to Fargo, North Dakota.

## SUMMARY AND CONCLUSIONS

A pollution evaluation survey was conducted on the Red River of the North from September 1969 to April 1970. The survey provided answers to several questions concerning pollution of the River.

Determination of the various seasonal waste contributions was accomplished. The total pounds of biochemical oxygen demand ($BOD_5$) discharged from the Fargo-Moorhead area during the survey period ranged between a low of 4203 pounds of $BOD_5$ per day in March to a high of 44,241 pounds of $BOD_5$ per day in October. The contribution of each major waste source in the Fargo-Moorhead Area to the total $BOD_5$ load was determined. The quantity of wastes from Fargo, North Dakota steadily increased as the efficiency of the plant declined during winter months with Fargo contributing a peak of 82 percent of the total organic waste load discharged from the Fargo-Moorhead area in March.

The combined waste discharges from the Fargo-Moorhead Area had an adverse effect on the water quality of the Red River of the North. Numerous violations of Federal-State Water Quality Standards occurred during the 1969-1970 survey period. These included violations of the dissolved oxygen criteria, the bacterial criteria and violation of State effluent requirements.

Specific conclusions that pertain to the Red River of the North within the study area and to Fargo's Sewage Treatment Plant are outlined below:

A. RED RIVER OF THE NORTH - FARGO, NORTH DAKOTA TO OSLO, MINNESOTA

1. The critical period for maintaining 5 mg/l of dissolved oxygen in the Red River of the North was during winter months under conditions of ice cover. Monthly averages of dissolved oxygen concentrations less than 5 mg/l were determined by samples selected from the Red River at three stream sampling stations in January, four stations in February, and two stations in March.

2. Waste sources in the Fargo-Moorhead area contributed abundant quantities of nutrients to the Red River of the North including nitrate-nitrogen and total phosphorus.

B. FARGO, NORTH DAKOTA - SEWAGE TREATMENT PLANT

1. The decreasing efficiency of removal of biochemical oxygen demand and total suspended solids by Fargo's Sewage Treatment Plant brought on by severely cold weather resulted in increased waste loads being discharged to the river adversely affecting the dissolved oxygen levels.

2. Monthly average effluent concentrations of the samples taken always exceeded North Dakota's effluent criteria of 25 mg/l $BOD_5$ and 30 mg/l of TSS.

3. Fargo was the major contributor of $BOD_5$ and TSS discharges to the Red River from the Fargo-Moorhead Area during the months of January, February, March, and April, contributing 43%, 61%, 32%, and 73% of the monthly average pounds of $BOD_5$ per day discharged and 57%, 64%, 61%, and 65% of the pounds of the monthly average of TSS per day discharged respectively.

4. Fargo's disinfection facilities provided sufficient bacterial removals to meet the effluent criteria during the survey period. However, it was noted by visitors to the plant on June 3, 1970, that no chlorine was being added and none was available at the plant.

## III. RECOMMENDATIONS

Those recommendations, based on the survey and a subsequent visit to the area, that apply to Fargo, North Dakota are outlined below:

1. Continuous disinfection should be provided for all wastes discharged from the City of Fargo.

2. The treatment facilities should be operated to effect the maximum practical reduction of nitrogen and phosphorus.

3. Wastes from the City of Fargo must be provided sufficient treatment to avoid damaging waste loads being discharged to the Red River particularly during the critical winter months.

## IV. METHOD OF STUDY

The 1969-1970 survey included that portion of the Main Stem of the Red River of the North from River Mile 274.0 at Oslo, Minnesota to River Mile 462.0 just upstream from the Fargo-Moorhead Area. The study area and sampling locations are shown in Figures IV-1 and IV-2. The station descriptions are given in Table IV-1.

### A. General Description

The pollution evaluation survey of the Red River of the North was conducted from September 1969 through the first week in April 1970. This time schedule was selected so that the seasonal changes during this period, especially under ice cover, could be monitored. Laboratory facilities were provided by the Civil Engineering and Microbiological Departments of the North Dakota State University. Samples were collected at thirteen stations spread over 182 river miles and from all known waste sources in the Fargo-Moorhead area. Visual observations were made between sampling intervals to maintain survey continuity.

### B. Sampling Schedule and Collection

Samples taken from the wastewater treatment plants, were composited on a two-hour basis for 24 hours. These composites were col ected for analysis three times a week. Analyses made on the composites included: chlorides, turbidity, conductivity (RB-3), suspended solids, pH, and BOD (5-day at 20°C).

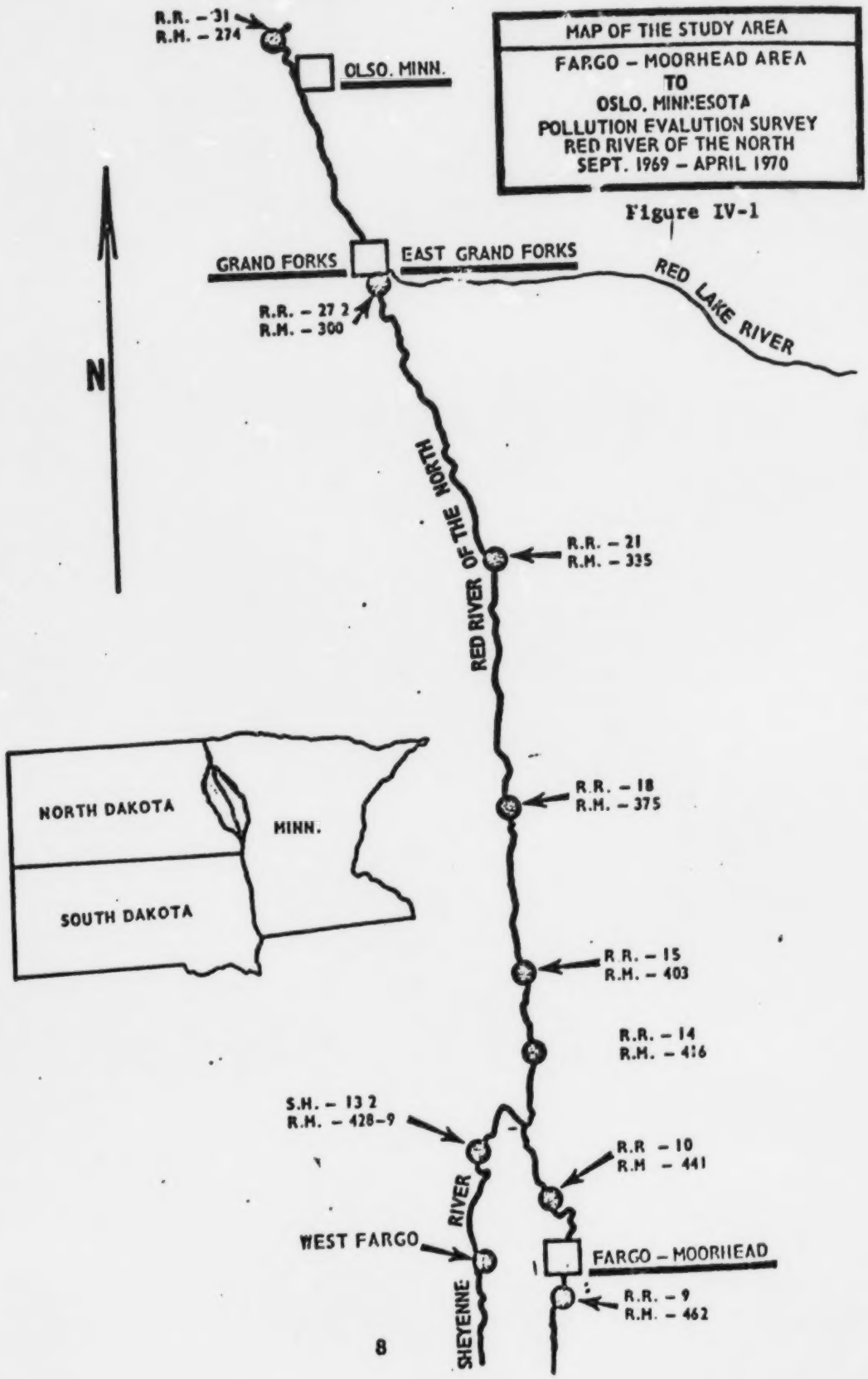
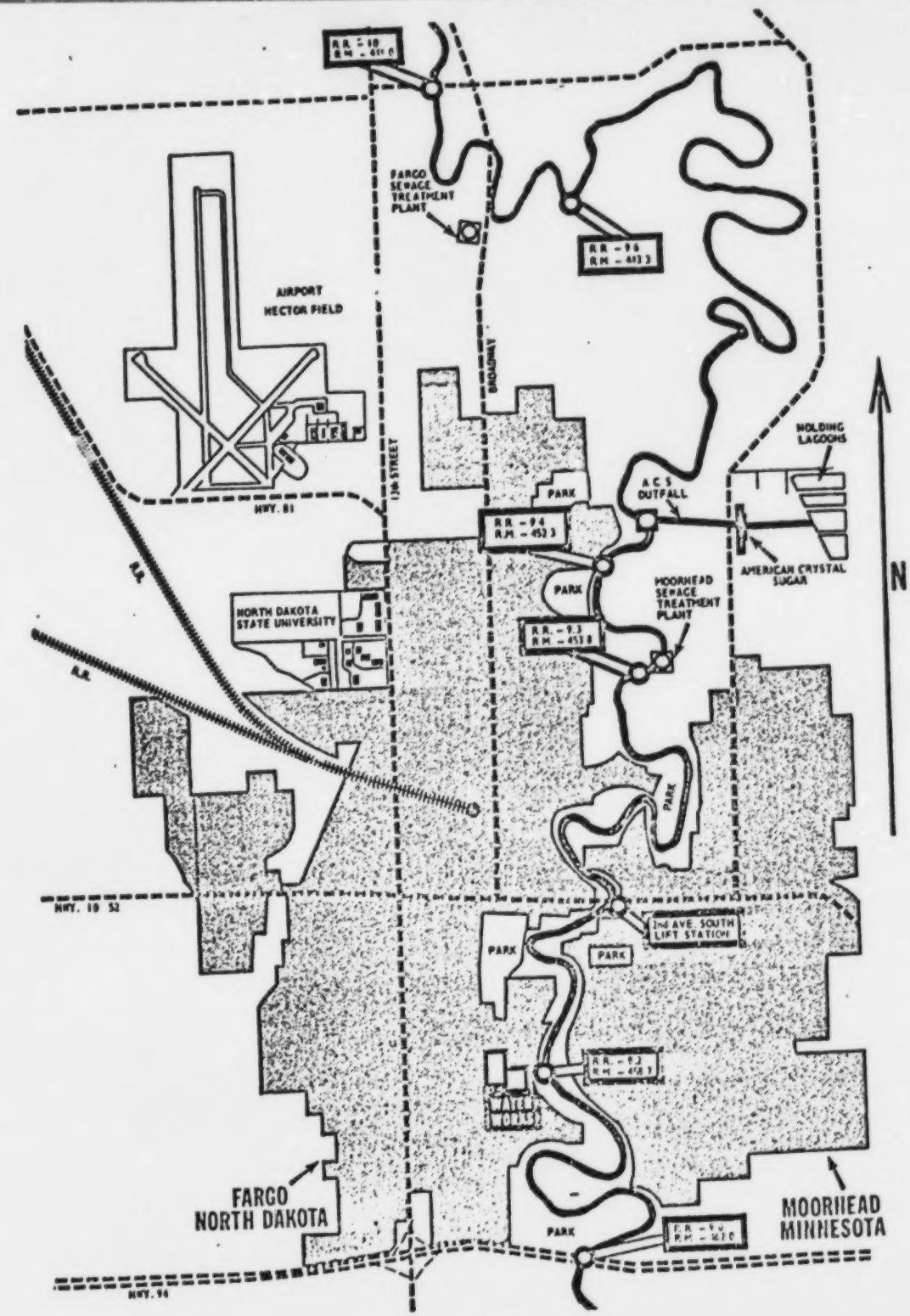

MAP OF THE STUDY AREA
FARGO – MOORHEAD AREA
TO
OSLO, MINNESOTA
POLLUTION EVALUTION SURVEY
RED RIVER OF THE NORTH
SEPT. 1969 – APRIL 1970
R.R. – 31
R.M. – 274
OLSO, MINN.
GRAND FORKS
EAST GRAND FORKS
RED LAKE RIVER
R.R. – 27 2
R.M. – 300
N
RED RIVER OF THE NORTH
R.R. – 21
R.M. – 335
NORTH DAKOTA
MINN.
SOUTH DAKOTA
R.R. – 18
R.M. – 375
R R. – 15
R.M. – 403
R.R. – 14
R.M. – 416
S.H. – 13 2
R.M. – 428–9
R.R – 10
R.M – 441
WEST FARGO
SHEYENNE RIVER
FARGO – MOORHEAD
R.R. – 9
R.M. – 462

Figure IV-1




MAP OF FARGO-MOORHEAD

POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPT 1969 - APRIL 1970

Figure IV-2

TABLE IV-1

STATION DESCRIPTIONS
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| Station | River Mileage | Station Description |
|---|---|---|
| RR-9 | 462.0 | Red River at I-94 Highway Bridge, Fargo, North Dakota. |
| RR-9.2 | 458.7 | Red River at Fargo Water Intake. |
| 2nd Ave. South Lift Station | 457.4 | 2nd Avenue South Lift Station By-Pass (when discharging). |
| RR-9.3 | 453.8 | Red River immediately upstream of Moorhead's STP effluent and above low head dam. |
| Moorhead STP | 453.4 | Moorhead STP Influent, Trickling Filter Effluent, Activated Sludge Effluent and Combined Chlorinated Effluent Composites. |
| RR-9.4 | 452.3 | Red River below Moorhead's effluent and above American Crystal Sugar's outfall. |
| American Crystal Sugar | 451.9 | American Crystal Sugar's Effluent (when discharging). |
| RR-9.6 | 443.3 | Red River at Cass County Farm below American Crystal Sugar effluent and above Fargo's effluent. |
| Fargo STP | 442.5 | Fargo STP Influent and Chlorinated Effluent Composite. |
| RR-10 | 441.0 | Red River at Minnesota Clay County # 22 Bridge below all Fargo-Moorhead effluents. |
| SH-13.2 | 428-9 | Sheyenne River at U.S. Highway 81 Bridge - 8 miles north of Fargo. |
| West Fargo | 428-22 | West Fargo Oxidation Pond Effluent (when discharging). |
| RR-14 | 416.0 | Red River at County Road Bridge at Georgetown. |
| RR-15 | 403.0 | Red River at County Road Bridge at Perley. |

TABLE IV-1 Continued

STATION DESCRIPTIONS
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| Station | River Mileage | Station Description |
|---|---|---|
| RR-18 | 375.0 | Red River at Halstad Bridge (USGS Gage). |
| RR-21 | 335.0 | Red River at Bridge West of Climax. |
| RR-27.2 | 300.0 | Red River at Grand Forks Water Intake. |
| RR-31 | 274.0 | Red River of the North at Highway 1 Bridge at Oslo, Minnesota. |

## V. DATA PRESENTATION

### A. Fargo Sewage Treatment Plant

Throughout the 1969-1970 survey period the known waste discharges in the Fargo-Moorhead Area were monitored. A summary of the results from Fargo's Sewage Treatment Plant is outlined below:

Fargo, North Dakota is served by a secondary sewage treatment plant consisting of primary clarifiers, two trickling filters operated in parallel, chlorination for disinfection and final clarification. During the 1969-1970 survey, composite samples were taken of the influent and chlorinated effluent. Tables V-1 and V-2 show the results and analyses on a monthly average basis for the 5 day, 20°C biochemical oxygen demand ($BOD_5$) and total suspended solids (TSS).

The percentage reduction by the treatment plant of $BOD_5$ and TSS is plotted on a monthly basis in Figures V-1 and V-2. Figure V-1 shows a decreasing trend in the percentage reduction of $BOD_5$ from 79% in November to 44% in April.

Figure V-2 shows the same decreasing trend for TSS. The percentage reduction goes from 88% in October to 52% in April.

The reduction in percentage removals from the fall to the winter months results from the decreased effectiveness during colder temperatures of the biologically dependent secondary treatment process.

The low percentage reductions in March and April are believed to be due to the effect of combined sewers which receive storm water and surface runoff in addition to sewage. The effect of these sewers is to increase the hydraulic loading while decreasing by dilution the strength of the sewage entering the treatment plant, which is

demonstrated in Tables V-1 and V-2 in the March and April $BOD_5$ and TSS data. The final effect of the higher flows and decreased strength of the sewage is the low percentage of removal during March and April.

The decreased removals result in an increase in the pounds of $BOD_5$ and pounds of TSS discharged to the Red River. The $BOD_5$ discharged increased from a low of 1,983 pounds per day in September to a high of 3,492 pounds per day in January. The pounds of TSS discharged also increased from 1,730 pounds per day in September and a low of 1,597 pounds per day in November to a high in March of 3,628 pounds per day. Monthly average influent concentrations of $BOD_5$ and TSS remained relatively constant except for the decreased concentrations in March and April. The influent concentrations are about average for a typical domestic sewage.

Monthly average effluent concentrations of the samples taken always exceeded North Dakota's effluent criteria of 25 mg/l $BOD_5$ and 30 mg/l of TSS.

TABLE V-1

FARGO SEWAGE TREATMENT PLANT
MONTHLY AVERAGES - BIOCHEMICAL OXYGEN DEMAND ($BOD_5$)
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| Month | $BOD_5$ Influent Conc. mg/l | $BOD_5$ Effluent Conc. mg/l | % Reduction Of $BOD_5$ | Flow MGD | Loading To Stream lbs. $BOD_5$/Day | Population Equiv. To Stream * Persons/Day |
|---|---|---|---|---|---|---|
| Sept. | 210 | 47 | 77 | 5.06 | 1983 | 11,664 |
| Oct. | 246 | 51 | 80 | 5.09 | 2165 | 12,735 |
| Nov. | 264 | 55 | 79 | 4.67 | 2142 | 12,600 |
| Dec. | 215 | 70 | 68 | 5.01 | 2925 | 17,205 |
| Jan. | 228 | 79 | 66 | 5.30 | 3492 | 20,541 |
| Feb. | 214 | 78 | 64 | 5.03 | 3272 | 19,247 |
| March | 175 | 63 | 64 | 6.56 | 3447 | 20,276 |
| April | 144 | 82 | 44 | 5.08 | 3474 | 20,435 |

* 0.17 lbs $BOD_5$ per capita per day

TABLE V-2

FARGO SEWAGE TREATMENT PLANT
MONTHLY AVERAGES - TOTAL SUSPENDED SOLIDS (TSS)
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| Month | TSS Influent Conc. mg/l | TSS Effluent Conc. mg/l | % Reduction Of TSS | Flow MGD | Loading To Stream lbs. TSS/Day | Population Equiv. To Stream* Persons/Day |
|---|---|---|---|---|---|---|
| Sept. | 287 | 41 | 86 | 5.06 | 1730 | 8,650 |
| Oct. | 333 | 43 | 88 | 5.09 | 1825 | 9,125 |
| Nov. | 245 | 41 | 84 | 4.67 | 1597 | 7,985 |
| Dec. | 258 | 64 | 75 | 5.01 | 2674 | 13,370 |
| Jan. | 194 | 71 | 63 | 5.30 | 3138 | 15,690 |
| Feb. | 218 | 82 | 63 | 5.03 | 3440 | 17,200 |
| March | 148 | 73 | 51 | 5.96 | 3628 | 18,140 |
| April | 130 | 62 | 52 | 5.08 | 2627 | 13,135 |

* 0.20 lbs TSS per capita per day

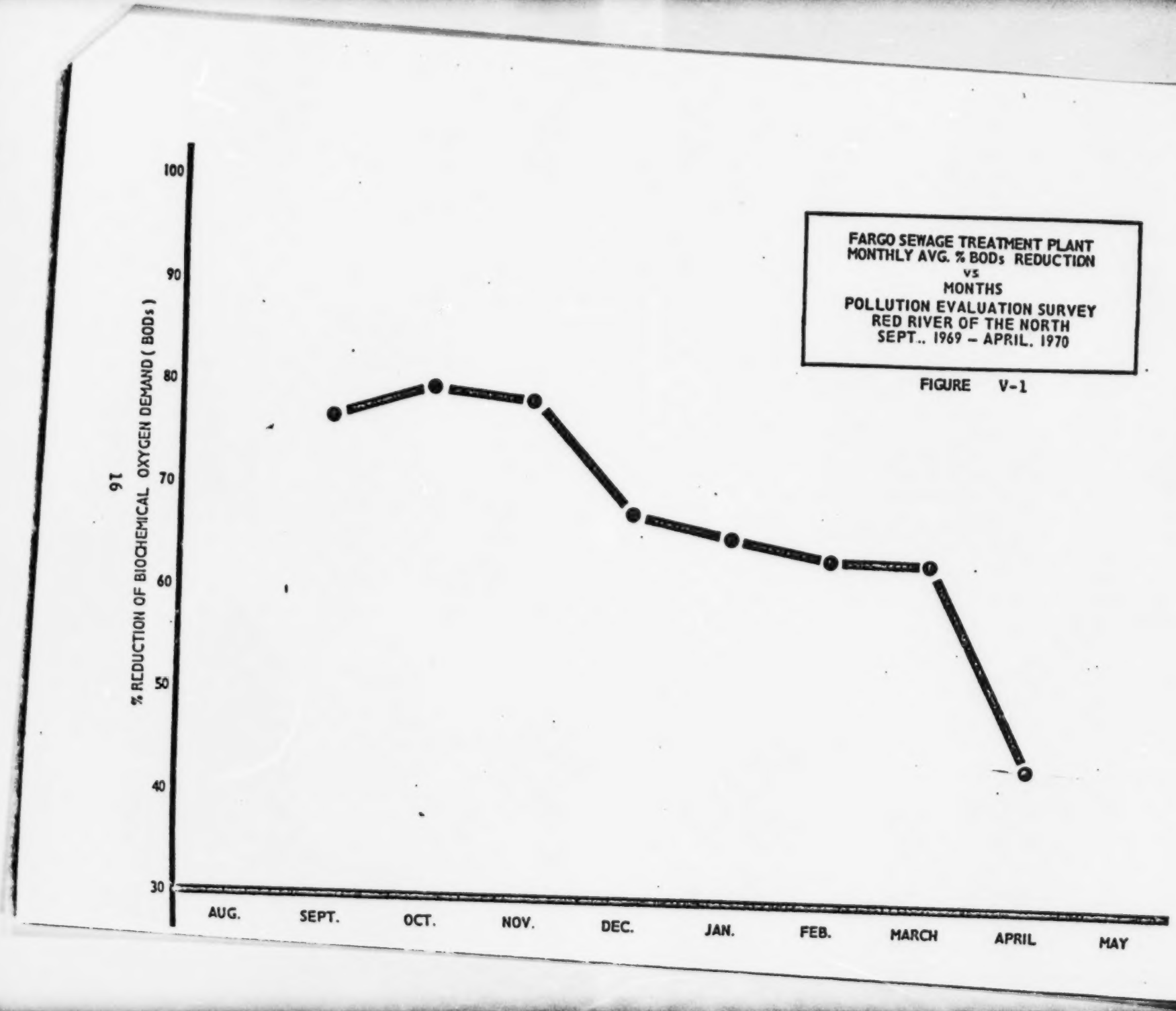
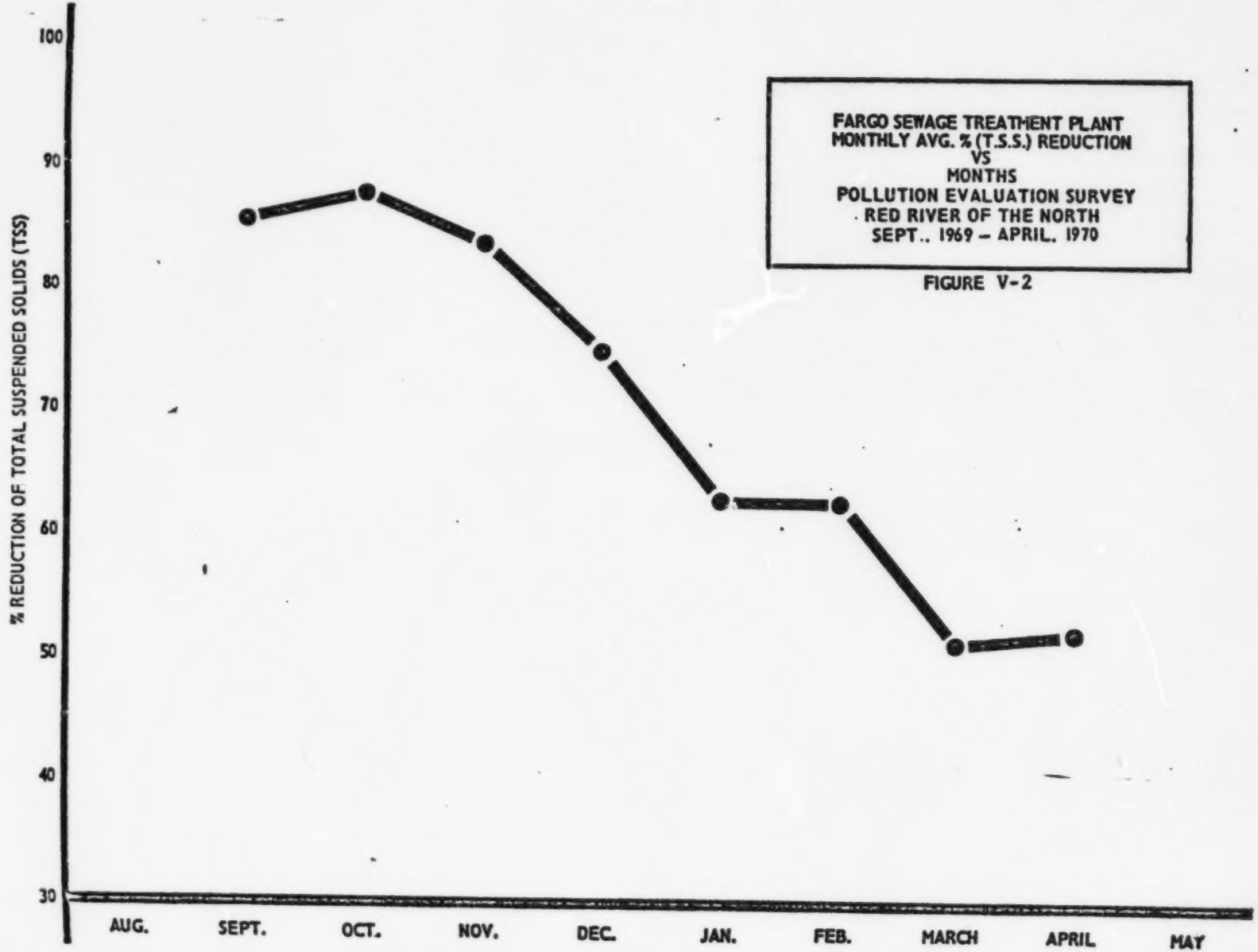

FARGO SEWAGE TREATMENT PLANT
MONTHLY AVG. % BODs REDUCTION
VS
MONTHS
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPT.. 1969 – APRIL. 1970
% REDUCTION OF BIOCHEMICAL OXYGEN DEMAND ( BODs )
100
90
80
70
60
50
40
30
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MARCH
APRIL
MAY

FIGURE V-1




FARGO SEWAGE TREATMENT PLANT
MONTHLY AVG. % (T.S.S.) REDUCTION
VS
MONTHS
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPT.. 1969 – APRIL. 1970

FIGURE V-2

B. Waste Discharges in the Fargo-Moorhead Area

Throughout the 1969-1970 survey period known waste discharges in the Fargo-Moorhead Area were monitored. From these results the waste contributions from these sources were determined. The monthly average pounds of $BOD_5$ per day discharged to the river ranged from a low of 4,203 pounds per day in March to a high of 44,241 pounds per day discharged during October. The monthly average pounds of TSS per day discharged varied between a low of 4,062 pounds per day in April to a high of 27,090 pounds per day in November.

Tables V-3 and V-4 give the monthly percentage contribution from each waste source for $BOD_5$ and TSS loads. Fargo was the major contributer during January, February, March and April contributing 43%, 61%, 82%, and 73% of the monthly average pounds of $BOD_5$ per day discharged and 57%, 64%, 61%, and 65% of the pounds of the monthly average of TSS discharged per day, respectively.

TABLE V-3

MONTHLY AVERAGE PERCENTAGES OF TOTAL LBS OF $BOD_5$
DISCHARGED TO THE RED RIVER FROM THE FARGO-MOORHEAD AREA
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| Month | Fargo Sewage Treatment Plant | Moorhead Sewage Treatment Plant | Second Avenue South Lift Station By-Pass Moorhead | American Crystal Sugar Moorhead Plant |
|---|---|---|---|---|
| Sept. | 34% | 14% | 8% | 44% |
| Oct. | 5% | 3% | 1% | 91% |
| Nov. | 5% | 2% | 1% | 92% |
| Dec. | 30% | 10% | 5% | 55% |
| Jan. | 43% | 12% | 6% | 39% |
| Feb. | 61% | 21% | -- | 18% |
| March | 82% | 18% | -- | -- |
| April | 73% | 26% | -- | 1% |

TABLE V-4

MONTHLY AVERAGE PERCENTAGES OF TOTAL LBS OF TSS
DISCHARGED TO THE RED RIVER FROM THE FARGO-MOORHEAD AREA
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| Month | Fargo Sewage Treatment Plant | Moorhead Sewage Treatment Plant | Second Avenue South Lift Station By-Pass Moorhead | American Crystal Sugar Moorhead Plant |
|---|---|---|---|---|
| Sept. | 34% | 11% | 7% | 48% |
| Oct. | 16% | 11% | 3% | 70% |
| Nov. | 6% | 3% | 1% | 90% |
| Dec. | 23% | 12% | 4% | 61% |
| Jan. | 57% | 32% | 5% | 6% |
| Feb. | 64% | 28% | -- | 8% |
| March | 61% | 39% | -- | -- |
| April | 65% | 35% | -- | -- |

C. Stream Stations

Table V-5 shows the monthly average values for dissolved oxygen (D.O.) for the various stream stations. Those values of D.O. less than 5 mg/l are underlined.

When the river becomes covered with ice, the addition of oxygen through natural reaeration and algae photosynthesis ceases. The impact of the wastes from the Fargo-Moorhead area when ice limits the supply of oxygen is reflected in the low monthly average D.O. values during January, February, and March. It is noted that during January, February, March and April, Fargo was the major waste contributer in the Fargo-Moorhead Area.

The bacterial quality of the stream was measured by the total and fecal coliform content during October and November of 1969 and again in January 1970. The total coliform concentrations exceeded the 5,000 MPN/100ml standard at many of the stream stations. Fargo's effluent never exceeded a concentration of 5,000 MPN/100ml during the survey period, indicating effective chlorination. However, during a visit to Fargo's plant by FWQA personnel on June 3, 1970, it was noted that no chlorine was being added to the effluent nor was any chlorine available at the plant.

TABLE V-5

STREAM STATIONS
MONTHLY AVERAGES OF DISSOLVED OXYGEN*
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| STATION | R.M. | DISSOLVED OXYGEN FOR MONTH OF (mg/l) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR |
| RR 9.0 | 462.0 | 9.1 | 10.9 | 11.6 | 12.6 | 12.6 | 13.0 | 13.1 | 10.8 |
| RR 9.2 | 458.7 | 8.2 | 11.2 | 12.0 | 12.5 | 12.6 | 12.3 | 12.9 | 10.8 |
| RR 9.3 | 453.8 | - | 10.1 | 11.2 | 11.9 | 12.0 | 12.2 | 12.8 | 11.3 |
| RR 9.4 | 452.3 | 6.9 | 8.9 | 11.2 | 12.6 | 12.5 | 12.6 | 13.4 | 11.6 |
| RR 9.6 | 443.3 | 0.7 | 4.0 | 9.1 | 11.1 | 12.2 | 12.0 | 12.7 | 11.4 |
| RR 10 | 441.0 | 6.6 | 3.6 | 8.4 | 10.7 | 11.0 | 11.6 | 12.6 | 11.5 |
| RR 14 | 416.0 | 10.2 | 7.7 | 7.8 | 8.0 | 7.0 | 5.1 | 7.0 | 8.0 |
| RR 15 | 403.0 | 10.4 | 8.4 | 7.2 | 8.0 | 6.1 | 4.8 | 6.4 | 7.8 |
| RR 18 | 375.0 | 13.7 | 11.6 | 9.0 | 8.7 | 4.8 | 4.1 | 5.9 | 7.8 |
| RR 21 | 335.0 | 10.6 | 12.4 | 10.5 | 8.0 | 3.5 | 4.4 | 4.7 | 6.9 |
| RR 27.2 | 300.0 | - | 9.1 | 9.9 | 8.6 | 3.2 | 2.8 | 3.4 | 7.0 |
| RR 31 | 274.0 | 8.9 | 10.9 | 12.0 | 11.0 | 10.9 | 9.8 | 9.2 | 9.1 |
| TRIBUTARY | | | | | | | | | |
| SH 13.2 | 428.9 | 10.0 | 11.5 | 11.4 | 10.9 | 6.6 | 4.5 | 8.1 | 8.4 |

* Values less than 5 mg/l Standard are underlined

D. Nutrients

Untreated domestic sewage normally contains between 4 and 8 mg/l of phosphorus (P). Certain types of secondary treatment such as activated sludge can remove up to 30 percent of this phosphorus if operated properly. Total nitrogen in raw sewage is present in (concentrations of about 45 mg/l), predominantly the reduced state comprised of organic nitrogen (Org-N) and ammonia nitrogen ($NH_3$-N). Secondary treatment results not only in a change in form of these compounds to the oxidized nitrite-nitrate forms of nitrogen, but also in removal of up to 50% of the total nitrogen.

Nitrogen and phosphorus compounds (nutrients) are found in treated sewage. These nutrients, when discharged to a stream, can under proper environmental conditions stimulate excessive growths of algae.

Stream observations demonstrate the significance of the Fargo-Moorhead area as a nutrient source. Table V-6 gives the monthly average nutrient loads in the Red River at Station RR-9 upstream from the Fargo-Moorhead area and at Station RR-10 downstream from all Fargo-Moorhead effluents.

An average of the data for the entire survey period indicates an increase in the total phosphorus from 318 pounds per day at RR-9 to 1,128 pounds per day at RR-10 which is greater than a three-fold increase. The organic nitrogen increased from 798 pounds per day to 1,539 pounds per day and ammonia nitrogen increased from 252 pounds per day to 1,050 pounds per day. An increase from 481 pounds per day to 797 pounds per day was noted for nitrate nitrogen.

TABLE V-6

STREAM STATIONS
MONTHLY AVERAGE NUTRIENT LOADS AT SELECTED STATIONS
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| | STATION RR-9 (R.M.- 462.0) | | | | | STATION RR-10 (R.M.441.0) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Load lbs/day | | | | | Load lbs/day | | | |
| MONTH | FLOW cfs | TP | ORG-N | $NH_3$-N | $NO_3$-N | FLOW cfs | TP | ORG-N | $NH_3$-N | $NO_3$-N |
| SEP. | 64 | 172 | 372 | 3.4 | 3.4 | 78 | 2270 | 2010 | 861 | 378 |
| OCT. | 86 | 143 | 532 | 14 | 9.2 | 107 | 825 | 658 | 715 | 265 |
| NOV. | 120 | 155 | 291 | 13 | 6.5 | 143 | 770 | 809 | 462 | 324 |
| DEC. | 111 | 173 | 323 | 6.0 | 12 | 126 | 788 | 760 | 713 | 455 |
| JAN. | 154 | 298 | 380 | 249 | 174 | 107 | 810 | 755 | 791 | 504 |
| FEB. | 173 | 233 | 615 | 364 | 364 | 185 | 619 | 937 | 1260 | 369 |
| MAR. | 256 | 276 | 994 | 525 | 539 | 270 | 1075 | 2140 | 1860 | 902 |
| APR. | 598 | 1095 | 2870 | 938 | 2840 | 609 | 1870 | 4240 | 1740 | 3180 |
| AVERAGE | - | 318 | 798 | 252 | 481 | - | 1128 | 1539 | 1050 | 797 |

## VI. DOCUMENTATION OF EFFLUENT CRITERIA VIOLATIONS

Table VI-1 gives a listing of the discrete data from Fargo's Sewage Treatment Plant which violates the effluent criteria established by North Dakota's Water Quality Standards. These criteria establish 25 mg/l of biochemical oxygen demand (5-day at 20°C) and 30 mg/l of suspended solids as maximum effluent concentrations on a daily average basis.

## TABLE VI-1

### TABLE OF STANDARDS VIOLATIONS
### FARGO SEWAGE TREATMENT PLANT
### POLLUTION EVALUATION SURVEY
### RED RIVER OF THE NORTH
### SEPTEMBER 1969 - APRIL 1970

| Station | River Mileage | Date | Time | $BOD_5$ mg/l | Suspended Solids mg/l | Comments |
|---|---|---|---|---|---|---|
| Fargo STP Effluent | 442.5 | 9/23 | comp | 56 | 49 | North Dakota has no effluent criteria for coliform densities. |
| | | 9/25 | comp | 58 | 32 | |
| | | 9/29 | comp | 28 | 42 | |
| | | 9/30 | comp | - | 58 | |
| | | 10/02 | comp | 40 | 40 | |
| | | 10/06 | comp | 29 | 38 | |
| | | 10/07 | comp | 34 | 34 | |
| | | 10/09 | comp | - | 54 | |
| | | 10/13 | comp | 50 | 46 | |
| | | 10/14 | comp | 59 | 42 | |
| | | 10/16 | comp | 70 | 40 | |
| | | 10/20 | comp | 44 | 40 | |
| | | 10/21 | comp | 46 | 40 | |
| | | 10/23 | comp | 46 | - | |
| | | 10/27 | comp | 49 | 48 | |
| | | 10/28 | comp | 47 | 50 | |
| | | 10/30 | comp | 105 | 48 | |
| | | 11/03 | comp | 56 | 56 | |
| | | 11/04 | comp | 53 | 42 | |
| | | 11/06 | comp | 67 | 38 | |
| | | 11/10 | comp | 40 | 32 | |
| | | 11/11 | comp | 50 | - | |
| | | 11/13 | comp | 66 | 50 | |
| | | 12/01 | comp | 50 | 34 | |
| | | 12/02 | comp | 47 | - | |
| | | 12/04 | comp | 63 | 58 | |
| | | 12/08 | comp | 64 | 48 | |
| | | 12/09 | comp | 75 | 54 | |
| | | 12/11 | comp | 96 | 72 | |
| | | 12/15 | comp | 90 | 64 | |
| | | 12/16 | comp | 85 | 56 | |
| | | 12/18 | comp | 81 | 378 | |
| | | 1/08 | comp | 88 | 68 | |
| | | 1/12 | comp | 78 | 74 | |
| | | 1/13 | comp | 100 | 64 | |
| | | 1/15 | comp | 84 | 66 | |
| | | 1/19 | comp | 71 | 74 | |

TABLE VI-1 (CONT.)

TABLE OF STANDARDS VIOLATIONS
FARGO SEWAGE TREATMENT PLANT
POLLUTION EVALUATION SURVEY
RED RIVER OF THE NORTH
SEPTEMBER 1969 - APRIL 1970

| Station | River Mileage | Date | Time | $BOD_5$ mg/l | Suspended Solids mg/l | Comments |
|---|---|---|---|---|---|---|
| Fargo STP Effluent (Cont.) | 442.5 | 1/20 | comp | 85 | 60 | |
| | | 1/26 | comp | 66 | 100 | |
| | | 1/27 | comp | 70 | 60 | |
| | | 1/29 | comp | 71 | 76 | |
| | | 2/02 | comp | 76 | 76 | |
| | | 2/03 | comp | 92 | 84 | |
| | | 2/05 | comp | 90 | 82 | |
| | | 2/23 | comp | 68 | 88 | |
| | | 2/24 | comp | 75 | 84 | |
| | | 2/26 | comp | 67 | 82 | |
| | | 3/02 | comp | 72 | 64 | |
| | | 3/03 | comp | 54 | 86 | |
| | | 3/06 | comp | - | 70 | |
| | | 4/06 | comp | 75 | 50 | |
| | | 4/07 | comp | 92 | 72 | |
| | | 4/08 | comp | 77 | 64 | |